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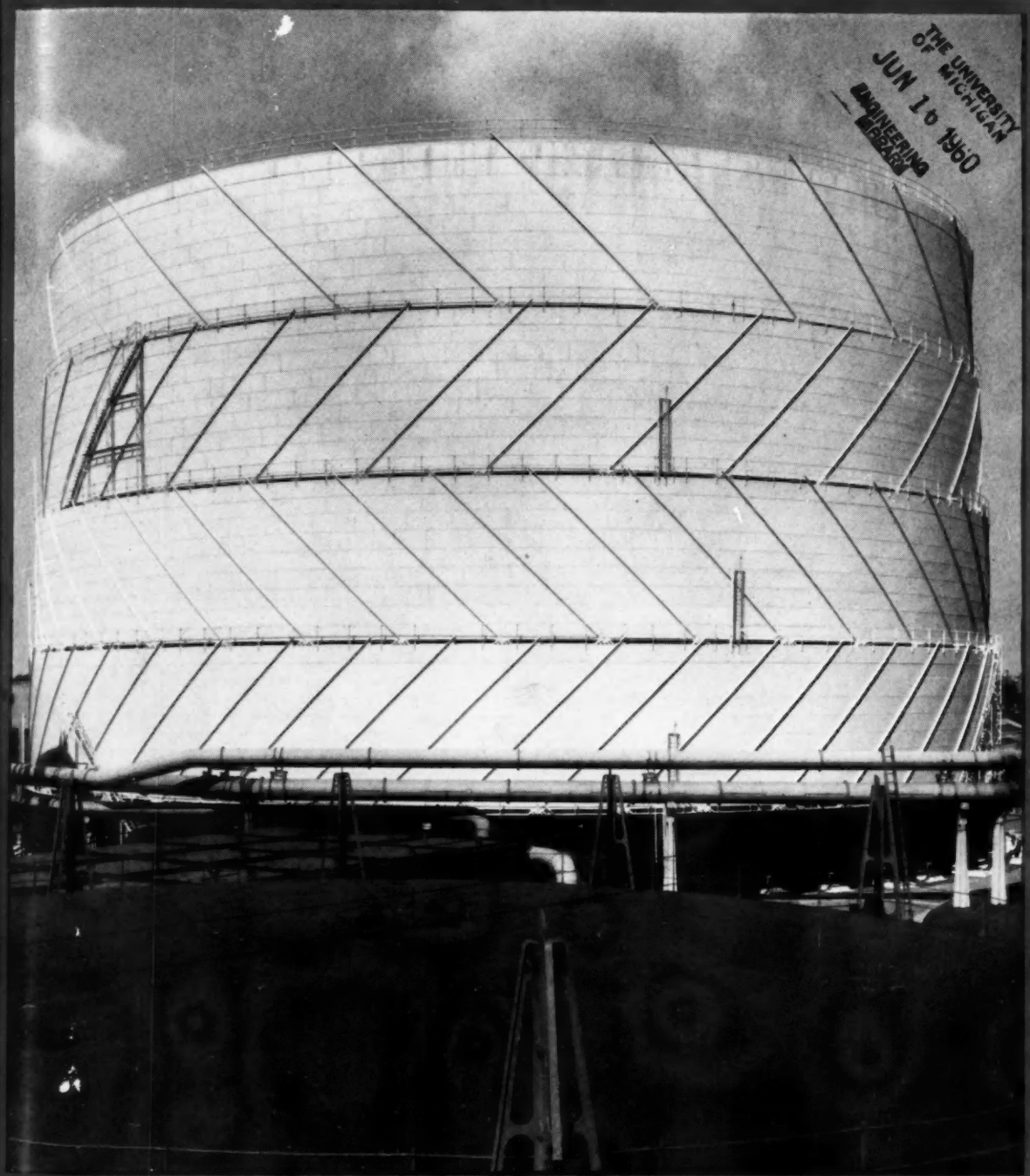

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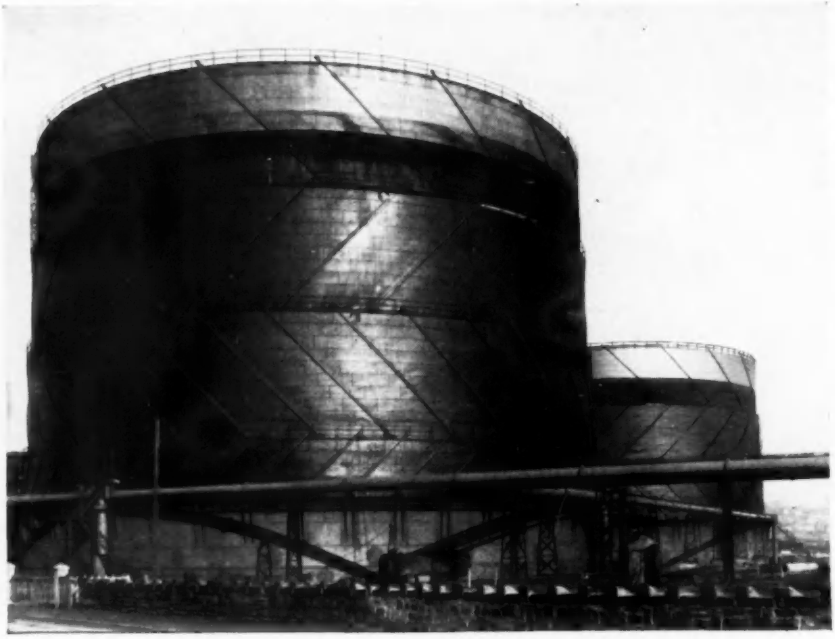

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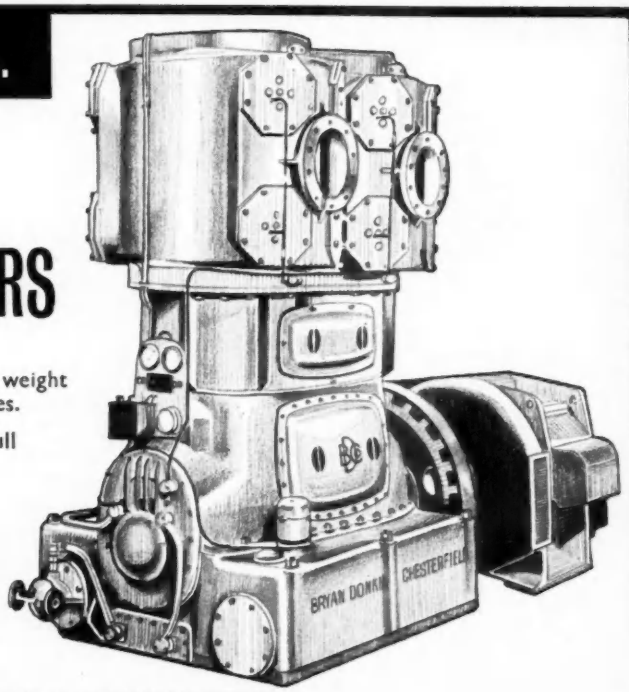

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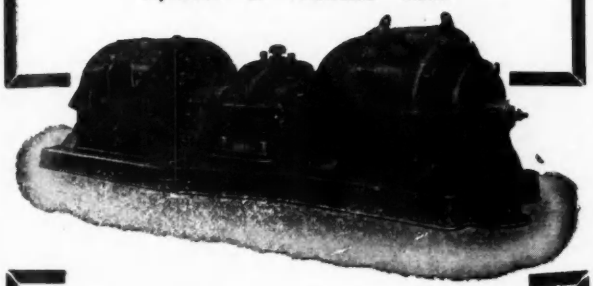

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Gas Journal

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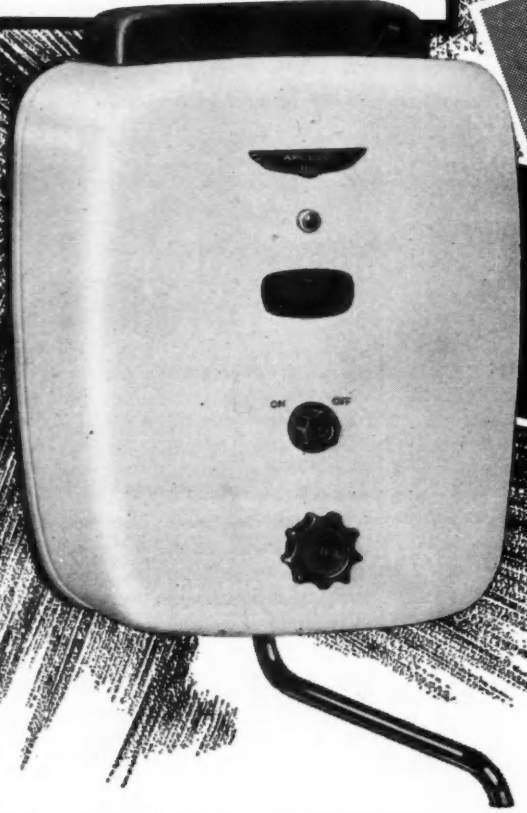

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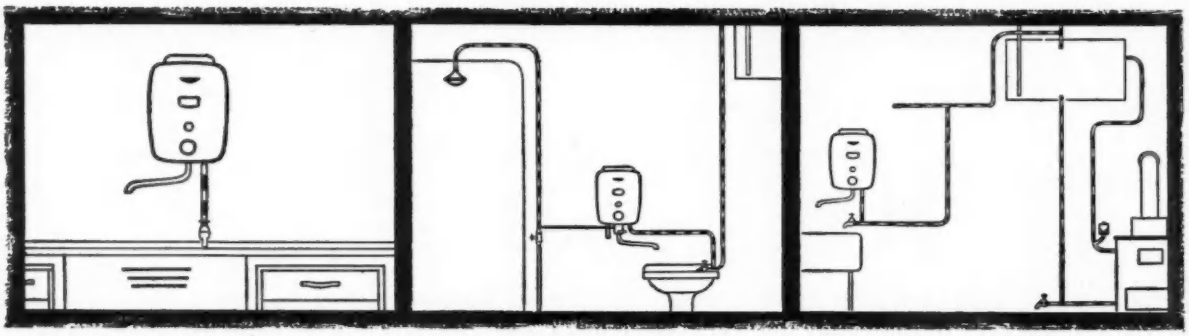

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Gas Journal

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Should engineers turn salesmen?

THE falling-off of the domestic load continues to be one of the most serious problems facing the area boards, in spite of the sales of appliances continuing at a high level.

It was with interest therefore that we read Mr. C. W. Butler's Presidential address to the Wales and Monmouthshire Juniors. Mr. Butler, who is the Engineer and Manager of the Holywell and Flint undertaking as well as Convenor of the Clwyd and Deeside group of the Wales Gas Board, stressed the need for those members of the Junior Association aspiring to higher positions, to concentrate more on management and sales than purely on engineering.

For a Junior Association to be given this advice from its new President is, we feel, something of an innovation, since the emphasis in the past has almost exclusively been on technical and engineering projects. Are we to gather from this that purely engineering problems have been solved for the time being and little further improvement is possible in gas manufacture and distribution until the cost of raw materials has been reduced and new types of plant have been developed and tested? Instead, should the gas engineer become a salesman? The answer to the first question is, we feel, undoubtedly, no; but before attempting to answer the second, it might be as well to look at the local conditions.

The Wales Gas Board is differently organised from any other of the 12 area boards, and as Mr. Butler reminded his listeners, the area of supply of the Principality is fast becoming connected to a 'national' grid. Wales is in some ways fortunate enough to be very heavily industrialised for the density of the population as a whole, which makes it possible to construct a grid system fed by sources of gas outside the direct control of the Board to a greater extent than elsewhere. This and the many scattered undertakings in the Board's area make a kind of local autonomy at undertaking level both possible and necessary.

The office of engineer and manager survives not only in name but also in function. It may be possible to centralise certain general functions such as accounting and engineering policy—and in those areas fed by the grid gas, manufacture also—but in the day-to-day work of the undertaking, its relations with the local population, its sales and service problems, and other local activities, remain very much more in the hands of the local chief executive officer than in other boards.

At undertaking level, therefore, the local distribution engineer may become the most important technical officer. Once the grid systems have been completed, gas-making costs are unlikely to fall very much since every source of cheap gas open to the Board is being exploited—coke oven gas, methane from mines and oil gas—so maintenance of the distribution system and a thorough check on all meters to reduce unaccounted-for gas is about as far as the undertaking can go.

Mr. Butler points out, however, that the engineer and manager can and should go out and become the 'commercial traveller' to his own undertaking. Contact with the district is most important, and he even recommends an officer in the undertaking standing for the local council to improve the liaison between the two bodies. At first sight such a suggestion might seem slightly immoral and a little shocking, but as Mr. Butler points out, it does at least enable a man to fulfil his duties as a citizen and at the same time to assist in putting over the gas message.

Is the need to sell more gas therefore becoming more important than to manufacture it at a lower cost? Again the answer to this must be no, but sales must somehow be increased. The function of the Junior Associations must, Mr. Butler thinks, be widened. No longer is it sufficient for papers on exclusively engineering subjects to monopolise meetings. Instead, speakers from outside must be invited to read papers on salesmanship, management and possibly accountancy. In this way the junior, whatever his function or whatever his age, will be taken out of the narrow circumscribed world of technical discussion and brought into the wider world of human relationships, commerce and business.

In the past it would seem that the need for this was not so important, but now the future of the industry is at stake unless all employed in it are equipped to put over the benefits of gas to the public.

The increased sales of appliances in the past few years is, we think, rather a false guide to the industry's pros-

perity. With the lifting of hire purchase restrictions a flood of purchasing power was released. For what? In many cases to replace old fashioned, inefficient, clumsy appliances, by modern, easily maintained equipment—almost all burning less gas.

Mr. Butler comments on the popularity of the two-part tariffs introduced by the Board—some 40% of the domestic consumers in his undertaking now buy gas under such a tariff—but no more gas is being sold. The effect has merely been to reduce the undertakings income without encouraging the domestic consumer to purchase other more varied types of gas-fired equipment in addition to the gas cooker. Is the solution to this merely to reduce the price of gas still further.

The need to reduce gas prices still remains, and clearly this can only be done by the most intense technological research on the development of new means of gas manufacture, but first every effort must be made to sell the gas now available by effectively presenting its advantages to the domestic consumer.

Is the hire worthy of the engineer?

LAST week, commenting on Mr. R. F. Robinson's Chairman's address to the London and Southern Section of the Institution, we attempted to answer the question 'What is an engineer?' This week we should like to consider the gas engineer in the perspective of the professional labour market.

First, however, may we remind readers of part of our definition? An engineer, we suggested, 'is a man of integrity as well as possessing a deep knowledge of the particular branch of his profession, with which he couples a feeling for economics and business, and sound commonsense. The training is hard and the need to compete with the operative at his own level may involve a long "apprenticeship" in the works. . . The engineer is quick to sense the change in economic atmosphere and is able to provide the proper solution when and where it is needed. His comprehensive training enables him to keep abreast of the technological advances of the time; he can understand the advantages to be gained from the new plant and machines becoming available, and when the economic climate is favourable, he can recommend their use. For it is the engineer rather than the scientist or the technologist, who eventually gets the plant installed in the newly laid-out works. It is he who has had to press the case for the new designs and it is on his judgment that the board chairman relies before he recommends the spending of large sums of money.'

One might suppose that men of this calibre are much in demand. They are. One might also suppose that they can command a pretty respectable salary. They can. That is why so few of them are coming to the gas industry, preferring to go to industries which are prepared to reward them adequately for their personal qualities and for their years of study and, possibly, experience. A great deal is talked about the difficulties of recruiting the right type of people to the gas industry, and various methods are employed to bring the attractions and virtues of the industry to the attention of graduates, students and apprentices. Yet with the exception of two or three realistic area gas boards, the financial 'inducements' offered are totally out of proportion to the salary scales operating in industry generally today; sometimes the remuneration is pathetic.

Let us just put matters into perspective. According to the latest Ministry of Labour statistics the average weekly earnings of manual workers in the manufacturing industries generally is 271s. 1d. per week; in the gas, electricity and water industries the figure is 250s. 4d. Yet one gas board is advertising for a divisional chief engineering assistant capable of preparing plans and specifications, of maintenance and control of all engineering and constructional projects at a salary of approximately £900-£1,000; and for a mechanical and electrical engineering assistant able to take complete control of maintenance of all mechanical and electrical equipment at a 24 mill. cu.ft. a day works for the same figure.

At a slightly different level is an advertisement for a commercial and domestic heating engineer/salesman to advise prospective consumers on central heating and other installations, who must have engineering training, be conversant with modern heating systems, and preferably be a technically qualified heating and ventilating engineer. Such a man is no ordinary salesman but an expert in a specialised field. Moreover, he is in demand. Heating and ventilating firms are crying out for men capable of coping with the growing boom in central heating. In the gas industry the part such a man must play is a vital one; unless his work is of first-class quality the installations for which he is responsible will not be 100% efficient, and the industry will be faced with a legacy of complaints. For such a man the board is offering a salary in the order of £770-£850 per annum, less than £70 more than the earnings of the average manual worker.

We should be sorry indeed if the board concerned, or any of the other boards which think in similar financial terms, were to misconstrue these comments. What we would ask them to do is to consider whether the interests of good operating economy are best served by employing personnel at the lowest possible salaries. Surely the most efficient operation of a works or indeed of any organisation is only possible if the best brains and skills are directing it? A racing car attempting the land speed record is a costly piece of machinery and cannot give the best results unless the driver is the best available. Beside the cost of the car and the rewards it can achieve the driver's salary is a fleabite. In its own way the gas industry also has a race to run, for unless it can produce cheaper gas and sell more of it, all within the space of the next two or three years, the results could well be serious. To win that race we need the best men on the market. We shall not get them unless we make it worth their while.

Among the most important in the world, the Olympia Exhibition has attracted 500 firms including over 100 from abroad, and has doubled in size since 1958.

1960 I.E.A. EXHIBITION

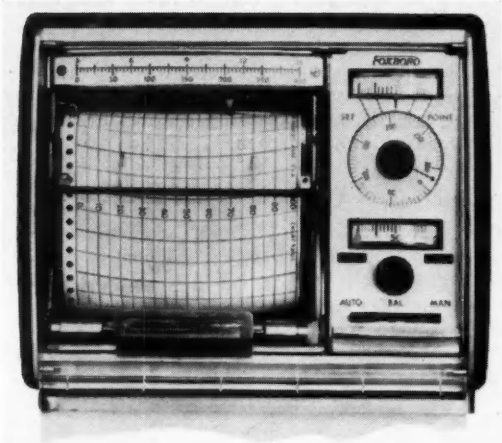
THE third I.E.A. Exhibition at Olympia last week emphasised how important instrumentation, electronics and automation have become to industry.

Opened by Lord Mills, the Paymaster-General, a former Minister of Power, the 1960 exhibition was twice the size of its predecessors and occupied the whole of the Grand and National Halls, including the first floor galleries. With nearly 500 exhibitors—over 100 from overseas—the I.E.A. has established itself as one of the greatest exhibitions of its kind in the world, and has attracted firms from the United States, Western Europe and from behind the Iron Curtain.

Instrumentation comes into its own

This exhibition stressed once again that instrumentation has now come into its own. No longer does the plant manufacturer consider it an appendage which might assist the plant operator, but realises that it must form an integral part of the original design of the plant layout itself.

The tremendous development in instrument design was evident from the exhibits, and the great possibilities to be realised from developments of new principles of measurement were to be seen on a number of stands. The improvement in methods of telemetering showed how this alone has increased the use of instrumentation generally and with it, remote and automatic control.



The new Foxboro electronic Consotrol recorder controller.

Electronics have been a big factor in this improvement, which in turn has made the modern computer possible. The logical outcome of this is automation which is fast becoming an entirely new technique for production control.

Going round the many stands, one was struck by the great demand for the multiplicity of components needed for remote controlled plants. Several firms showed computers, many showed ancillary appliances such as gauges, remotely controlled valves, electronic computers and quality control appliances, and some demonstrated complete plants controlled by the most up to date automation devices, the actual plant working being simulated by an analogue computer.

Of the individual exhibits themselves, these were very diverse and covered a wide field.

On their electronic apparatus division stand, **Associated Electrical Industries Ltd.** showed static switching elements applicable to any sequencing problem and photographs showing the application of A.E.I. electronic equipment to machine tools. Other exhibits included a transistorised photo-electric relay and counter, a model of a reversing cold rolling mill under the control of an electronic counter, an infra-red radiation pyrometer and controller—a scale model of an A.E.I. 1010 digital computing and data processing system—a fast transistorised computer and also an A.E.I. 955 analogue computer. There was also a display of components heat treated by high frequency induction heating and microwave test equipment.

Pulse height analyser

On their instrumentation division stand they showed a pulse height analyser and potentiometric recorders—both single point integrating and 16-point with print-out types. Among new items shown for the first time were a 10-in. potentiometer indicator/controller and a 4-in. multipoint recorder.

Their radio and electronic components and telecommunications divisions also had interesting exhibits, and

among those of the latter division was equipment for transmission of five telephone channels simultaneously over one radio link.

The Audco Annin division of the **Audley Engineering Co. Ltd.** displayed a number of examples, both static and working, of the manually operated and power operated Audco Annin valves, suitable for line pressures up to 6,000 p.s.i. Manufactured in all sizes up to 10 in. in ferrous and non-ferrous metals, the range included the Wee Willie valve which is capable of controlling very small flows at pressures up to 50,000 p.s.i.

Baird & Tatlock (London) Ltd. in their range of Analmatic equipment for automation in analysis showed the auto-titrator (burette type), the auto-titrator (motorised pipette type), the Cambridge polarograph, the wide bore polarograph, and the Karl Fischer titrator, proportioning pipette, and the volumetric dispensing pipette. In the field of general laboratory instruments and apparatus, they exhibited new and standard equipment from their well-known ranges, including autoclaves, balances, centrifuges, and oil testing apparatus. There was also a complete range of chromatography apparatus, microchemical apparatus and sintered glassware to be seen on this stand.

Black Automatic Controls Ltd. included in their exhibits this year a prominent display of valves and pressure switches; these have been designed to meet conditions where high operating pressures and temperatures are to be found. There was also a wide range of controls to cater for the needs of industry using pneumatics and hydraulics, seen on this stand.

The British Rototherm Co. Ltd. showed a comprehensive range of dial thermometers, recorders and controllers, among which were bi-metal indicating thermometers, mercury-in-steel indicating thermometers which included rigid stem and distant reading models, and special industrial designs, vapour pressure indicating thermometers in dial diameters from 2½ in. to 10 in., and temperature pressure vacuum and compound recorders for wall and panel mounting.

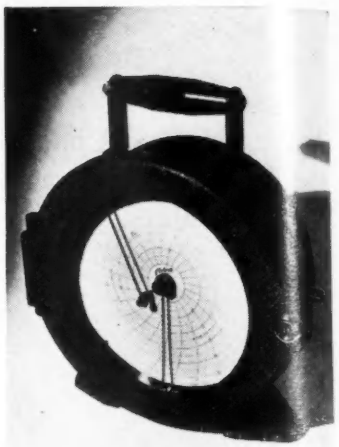
Interesting photographic display

The electronic division of **Bruce Peebles & Co. Ltd.,** had an interesting photographic display of their organisation. Among the firm's activities are the design and manufacture of a number of systems connected with automation and automatic control, including quality control, inspection and electro-hydraulic mechanisms. They manufacture analogue computer units and M-scope pipe and cable finders.

The Department of Scientific and Industrial Research showed 26 instruments on their stand which represented

Range of new Arkon flow meters.

New Arkon portable pressure recorder.



the activities of 12 individual research organisations of very wide interest. Among those instruments were an ultrasonic goniometer from the National Physical Laboratory, a curve reading apparatus from the Hydraulics Research Station and a 'solid image' microscope from the University of Cambridge psychology laboratory.

Elliott-Automation Ltd., had three stands. Between them they covered the major activities of this organisation which consists of some 50 individual firms, covering every aspect of instrumentation, process control and automation. On the main stand were shown the Panellit 609 industrial information unit, incorporating as its central controlling unit an Elliott 803 digital computer, the Elliott Optimat optimising unit, and a constant weight feeder, representing the industrial weighing activities of Elliott Bros. Ltd. The valve interests of the group were represented by exhibits by the Fisher Governor Co. Ltd., which showed the versatility of this firm's equipment, its automatic valve operators and its piston and other types of actuator. Automatic process control was represented by displays by Electroflo Meters Ltd., James Gordon & Co. Ltd., and the process control division of Elliott Bros. (London) Ltd. Elliotts Nucleonics Ltd. showed transistorised reactor control instruments.

Englehard Industries Ltd., are engaged in the refining and fabricating of the precious metals for all industrial applications. Their exhibits included the Hersch oxygen meter, for the detection and continuous measurement of traces of molecular oxygen in gases covering the ranges 0-10 and 0-100 v.p.m. and the Deoxo indicator for the detection and continuous measurement of traces of oxygen and hydrogen in gases, covering the maximum range of 1% oxygen and 2% hydrogen.

Plastic body valves

Ether Ltd., and **Electro Methods Ltd.,** showed a complete range of temperature measuring and control instruments including millivolt and potentiometric types. Solenoid valves for all gases and fluids were also on view, the most notable of which were the plastic body valves. In addition to the low inertia motors, relays, magnetic amplifiers and a range of printed circuits, the entirely new Xactrol potentiometer recording controllers, series 2000, were shown. These latter have a patent zero-load and zero-differential control system.

There were a variety of new products to be seen on

(*Continued on p. 343*)

From a paper to the Midland Junior Gas Association.

The design and operation of an axial flow compressor station—*Part II*

By J. D. CORMACK, Assoc.M.Inst.Gas E.,

DEPUTY DIVISIONAL DISTRIBUTING ENGINEER,
BIRMINGHAM DIVISION, WEST MIDLANDS GAS BOARD.

ALTHOUGH only two machines are to be installed initially, the station has been laid out to accommodate up to four units, and the automatic control gear has been designed to allow the parallel running of any two compressing sets. By a proportional potentiometer at the control desk the relative outputs of each compressor can be adjusted during parallel running.

The compressor can operate at pressures between 7½ p.s.i. and 25 p.s.i. and deliver a volume of 600,000 cu.ft. per hour at maximum pressure. Fig. 3 shows the pressure/volume curve for the machine, upon which have been superimposed speed lines and operating zones for the 'speed lock' and the automatic bypass valve.

The surge line is clearly indicated and the compressor must always operate to the right of this line; the automatic bypass valve provides for this. If, for instance, gas is being delivered into the main at 15 p.s.i. and the district demand is 350,000 cu.ft. per hour, the compressor will actually handle 475,000 cu.ft. per hour at this pressure, and the difference between the two figures will be automatically bypassed to the inlet main.

Sustained running not tolerable

In the interests of economy, however, sustained running under such conditions could not be tolerated. The normal schedule of working ensures as far as possible that the machine runs clear of bypassing conditions except when starting up and shutting down.

The present valve opening lines provide a liberal margin

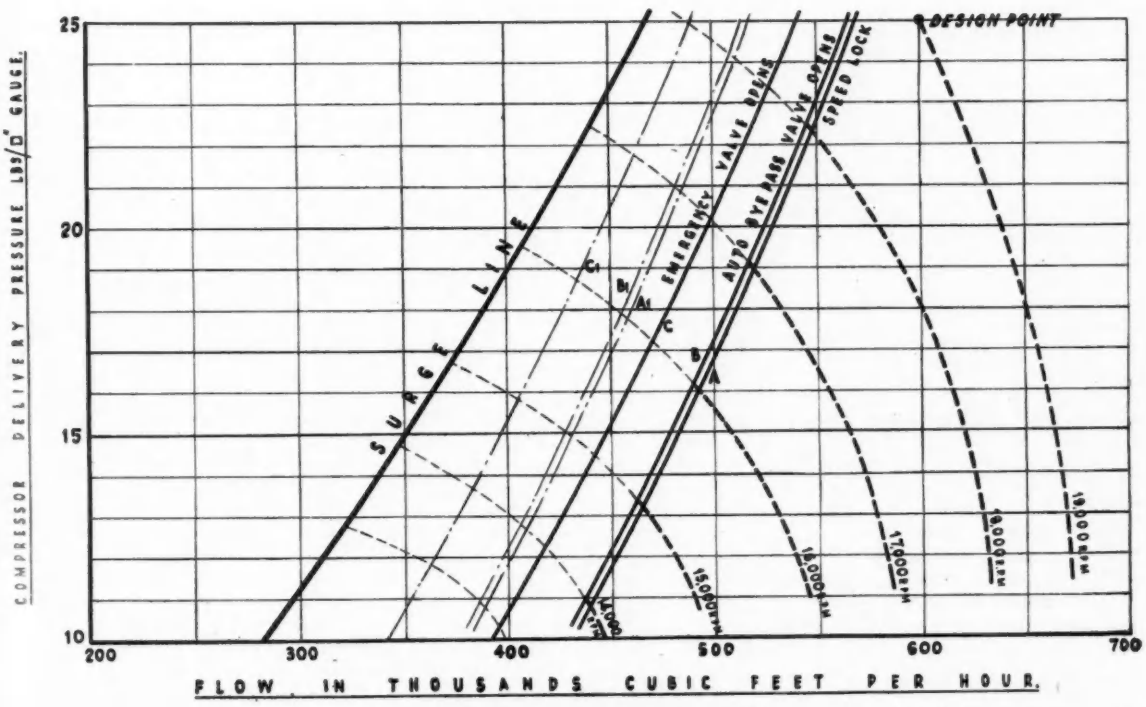


Fig. 3. Axial flow compressor characteristics.

of safety against surge—most important during the proving period of the machine. Now that sufficient experience has been gained, however, an adjustment of these zones can be considered, and it is intended to move the lines towards the surge line by some 50,000 cu.ft. per hour. which will improve the machine's flexibility—see lines A_1 B_1 C_1 Fig. 3.

The bypass control equipment is designed to start opening the valve at a predetermined point lying to the right of the surge line, and the degree of valve opening is dependent upon district demand. At a given pressure, therefore, the volume of gas being handled by the compressor should never fall below a specified minimum.

Valve control is effected by the 'minimum flow controller,' which is another jet pipe unit similar to that governing the machine speed (Fig. 4). Connections are taken from the oil pressure ports in the distributor plate to either end of the operating piston which is mechanically linked to the bypass valve. Movement of the jet will then result in a change of valve position.

The jet pipe comes under the influence of forces derived from (a) the pressure at the outlet of the compressor, (b) the flow to the inlet of the compressor, and (c) the flow in the bypass main. These forces are applied horizontally to each end of the jet pipe carrier assembly. Bypass flow is applied by means of a bellows unit, main flow by differential pressures across a diaphragm, and delivery pressure through a combination of a spring and bellows operated cam.

Oil is supplied to the controller at 70 p.s.i. direct from the main lubricating oil system and when the bypass valve is shut the jet of oil is directed on to the appropriate orifice, applying full pressure on one side of the piston. As conditions approach the valve opening line, the jet pipe under the influence of the three forces, changes its position, thus causing a redistribution of hydraulic pressure which opens the valve. When the appropriate volume of gas is being bypassed, the jet pipe returns to its mid-position and the valve remains stationary until flow and pressure conditions at the compressor demand a further change. Oil on leaving the distributor plate, passes into a reservoir and gravitates back to the lubricating oil sump at the base of the main machine.

Cut-off and equalising valves are fitted in the oil lines to the piston for safeguarding the machine in the event of oil failure.

A hand/emergency valve is fitted in a secondary bypassing circuit which comes into operation in the event of failure of the automatic bypass valves (lines C and C_1, Fig. 3).

A 'surge detector' unit has been devised to perform two safety functions, namely, to maintain a fixed compressor speed under certain pressure and flow conditions (speed lock), and to operate the emergency bypass valve should the automatic valve fail to function.

Early experiences showed that when speed changes were being made at a point where the automatic valve was about to open, the controllers governing the scoop tube and bypass valve tended to react against each other, resulting in severe fluctuation of machine speed and valve opening.

A speed locking device was introduced as a stabiliser,

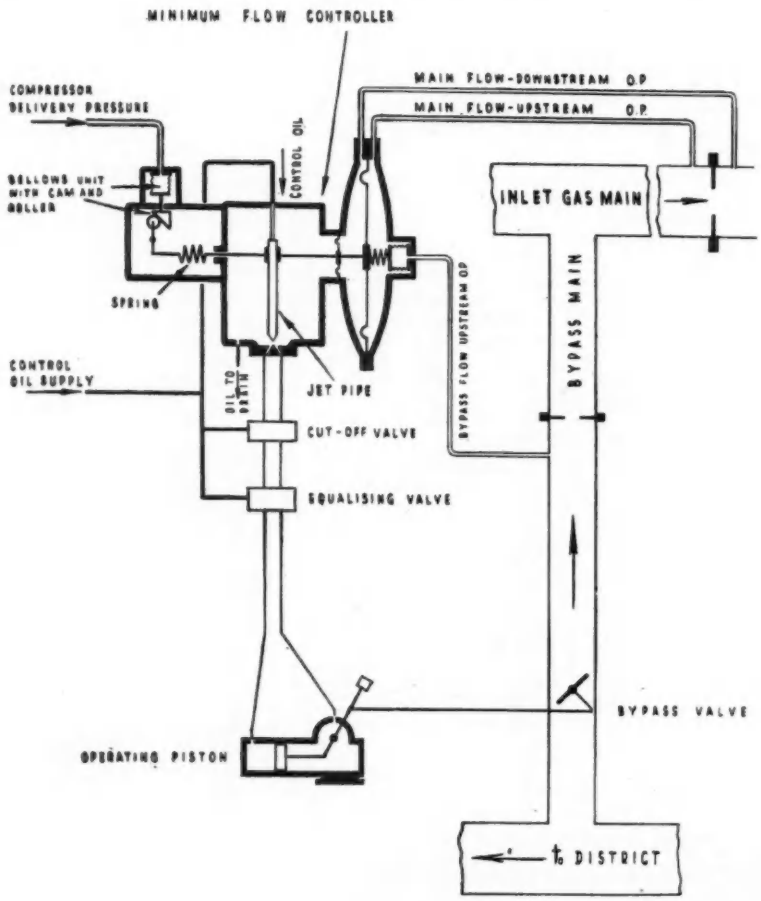


Fig. 4. Diagrammatic arrangement of automatic bypass control.

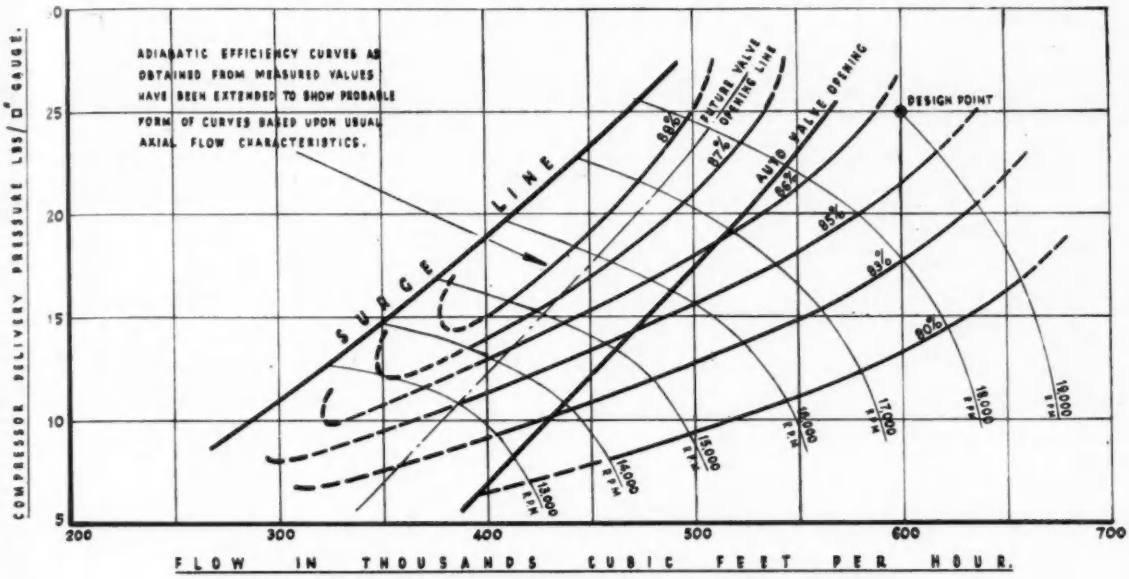


Fig. 5. Axial flow compressor characteristics. Adiabatic efficiency.

which over-rides the speed controller and hydraulically locks the scoop tube just prior to the automatic valve opening. Under these conditions further opening of the valve is controlled entirely by changes in district pressure, the flow through the machine remaining constant—see Fig. 3.

The correct operation of the automatic valve is of paramount importance, since any deficiency in the equipment might well cause extensive damage to the compressor. A second line of defence has, therefore, been provided to safeguard the machine in the event of such failure. Before dangerous conditions are reached, the surge detector will trip open the emergency valve by means of a solenoid, causing the full compressor flow to be bypassed.

All important data relating to the machine's performance is transmitted to a focal point—the control room—enabling a constant check to be maintained on the performance of the compressor and ancillary equipment.

Electrical control cabinets are situated on either side of the central desk and house switchgear and instruments relating to the main motor and auxiliaries. These cabinets have been extended to accommodate instruments displaying gas flows, gas pressures, machine speed and vibration readings.

In view of the importance of avoiding surge conditions, a constant check is maintained on the performance of the bypass gear, and an instrument—'surge line indicator'—has been devised to indicate continuously operating conditions relative to the surge line. The operating position is indicated by the intersection point of two needles—one showing flow, the other delivery pressure. Various curves have been inscribed on the back plate of the instrument, representing the surge line, the 'emergency valve trip' and the 'speed locking' lines.

Any peculiarities in the behaviour of either the 'speed lock' or bypass control gear will be shown on this instrument.

Situated adjacent to the compressor is a panel incorporating sufficient instruments to permit manual operation of the machine should failure of the electronic equipment occur. A duplicate surge line indicator allows flow and pressure to be kept under observation during any manual control of the bypass valve.

One of the principal merits of the axial flow compressor is the relatively high efficiency of compression possible between wide limits of operation. Fig. 5 shows the pressure and volume graph, upon which have been plotted adiabatic efficiency curves, *i.e.*, the ratio of theoretical work done under adiabatic compression to the actual work between the same limits of compression.

Adiabatic efficiencies of up to 87% can be obtained near the surge line, but it is impracticable to use this particular region if a satisfactory margin of safety is to be provided. Nevertheless, figures between 82% and 86% can be achieved over the useful working range of the machine.

Allied to these high compressor efficiencies, it has been possible to incorporate an epicyclic gearbox with an efficiency of 98%, a fluid coupling and a 3,000-V, 3,000-r.p.m. squirrel cage induction motor, with an efficiency of 94%-96% at a power factor of .9 to .91.

The operating efficiency of the fluid coupling, apart from small losses due to windage (approximately 1%), is directly proportional to the ratio of the output to input speeds. In order to obtain the best performance from the complete installation, the compressor must, therefore, be run at maximum speed and as near the design point as possible; inter-station operating arrangements and pressure schedules are compiled with this in mind.

Compressor cleanliness is one of the most important factors is maintaining good performance figures, and special attention has been given to the removal of deposit contaminating the bladed section of the machine.

During the 1959 August shut-down period the compressor was dismantled and the condition of the blades was examined, since in spite of daily cleaning, it had not been found possible to achieve 'clean compressor' performances. The machine had by that time run for approximately 1,500 hours since the previous inspection. Examination of the blades revealed that while those on the rotor were relatively clean, there was a coating of deposit on certain stator blades, particularly in the first few stages.

The deposit proved somewhat difficult to remove, for it

was encrusted on the affected blades, and could only be cleared by using a bristle brush and benzine fluid. It would seem that the present cleaning technique removes the bulk of deposit but does appear to leave a small amount untouched, and that over a period of time the accumulation becomes noticeable in the performance figures.

Experience indicates that a thorough internal cleaning, involving dismantling the machine, might be required annually; needing about two days to complete, it can be conveniently carried out during the shut down period over the industrial holiday fortnight.

Routine internal cleaning of the compressor is undertaken before each daily run and involves the injection of a fluid through tubes fitted radially at the compressor inlet. The cleaning fluid is conveyed to these tubes from a sump by a hand-operated semi-rotary pump while the machine is running down from 5,000 r.p.m. to 2,000 r.p.m. Experiments have been made with different liquids, the best results being obtained from the use of good quality benzine.

To achieve the greatest economy in operation, the machine must be run as near as possible to its maximum volume output, and at a delivery pressure compatible with district requirements.

High industrial load

The high pressure gas demand in Birmingham, with its high proportion of industrial load—approximately 50%—is such as to enable the plant to work at economical conditions for six to eight hours a day, six days a week throughout a large part of the year. The station is normally manned on a one-shift per day basis—6.30 a.m. to 2.30 p.m., on Monday to Friday, and 8 a.m. to 4 p.m. on Sundays—although during the peak winter period a second shift allows the plant to run for about 11 hours per day.

High volumetric outputs from the other compressor station at Windsor Street are not essential for maintaining good efficiency of compression at that station, since the plant includes steam driven reciprocating compressors which maintain a good overall efficiency over a wide range of conditions.

Before building the station at Washwood Heath, the Windsor Street compressors worked to a daily prescribed pressure schedule, aimed at ensuring adequate pressures throughout the system, but avoiding, as far as possible, a pressure build-up during off-peak periods. Provided gas requirements are within the available pumping capacities it is not difficult to achieve the pressures needed but even if the daily characteristics of the system are accurately known, the unexpectedly high demand must be provided for; the adequate margin of safety needed in the schedule for this may cause a certain degree of over-pressurisation.

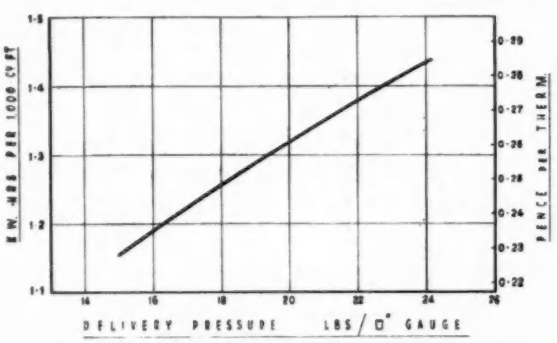


Fig. 6. Power consumption at maximum speed.

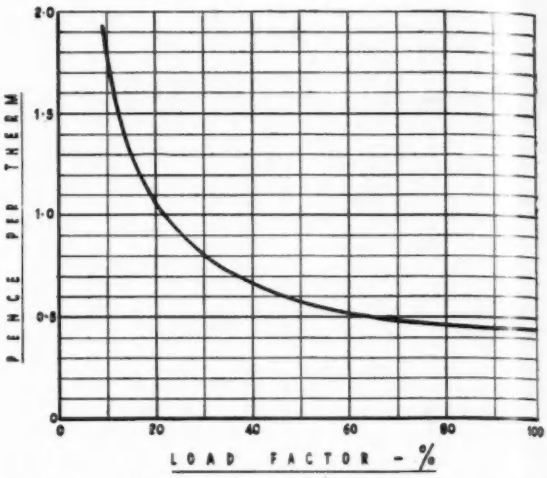


Fig. 7. Station operating cost relative to load factor.

When manned, the new station provides the means of carefully controlling delivery pressures in accordance with demand, a feature not easily achieved before.

The Longbridge district governor is a partially manned station, where limited facilities are available for advising Washwood Heath of terminal pressures, and from this information the Washwood Heath operator adjusts delivery pressures at the two stations accordingly. It is intended that Longbridge pressures shall be remotely indicated in the control room. Post Office lines have been reserved and the equipment which is on order will be installed in the very near future.

The Longbridge high pressure storage station is normally fully charged, and is set to feed gas into the system automatically should terminal pressures fall to a predetermined level.

In the interests of overall economy, the volume of gas handled by the high pressure system is kept to a minimum, and to this end district governor pressures are adjusted, either manually or automatically, to a strict schedule, thus ensuring full exploitation of the low pressure distribution system radiating from the central Birmingham gasworks.

Station operating costs, which are calculated from the summation of the charges for (a) electric power—units consumed and maximum demand charges, (b) annual charges on plant, buildings, etc., (c) maintenance and (d) attendance, are influenced to a minor degree by delivery pressure.

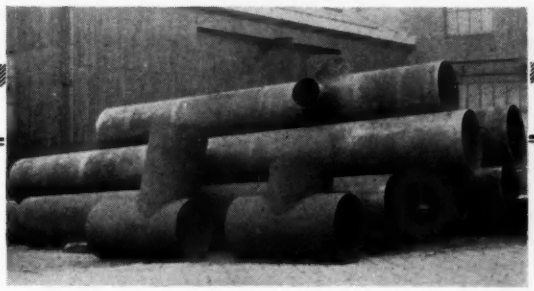
Total power requirements

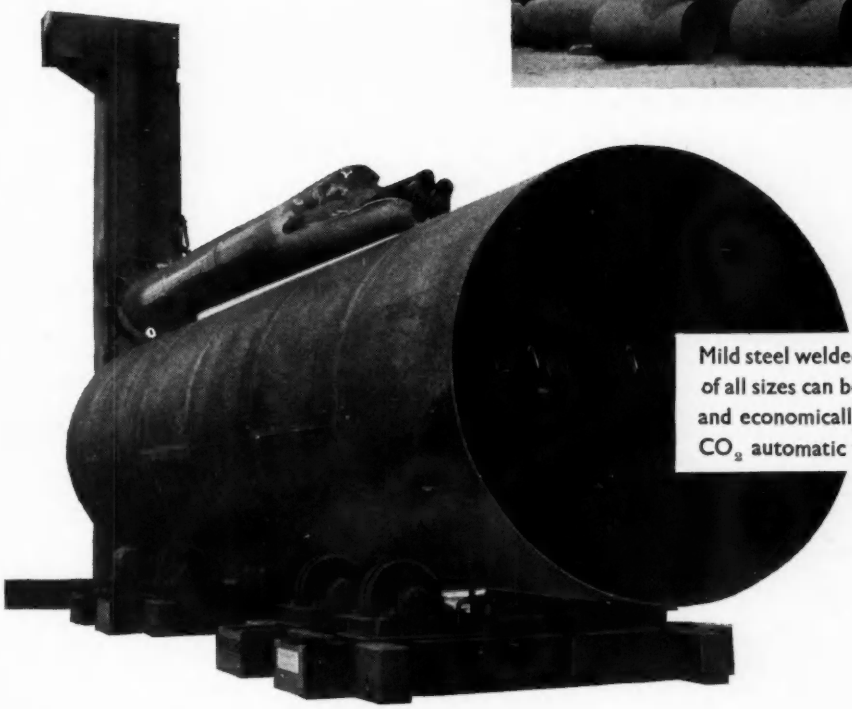
The curve in Fig. 6 shows, in terms of kW. hours per 1,000 cu.ft., the total power requirements of the installation (including auxiliary equipment) for given delivery pressures when the machine is running at maximum speed. These requirements are also translated into pence per therm, based upon a unit charge of .89d.

The major factor affecting operating costs is, of course, the volume of gas being handled by the plant, *i.e.*, the station load factor. The kVA and fixed overhead charges have the effect of reducing the cost per therm as volumes increase and the load factor improves. Fig. 7 illustrates the effect of load factor on the overall cost per therm when operating at a delivery pressure of 20 p.s.i. (unit charge of .89d.).

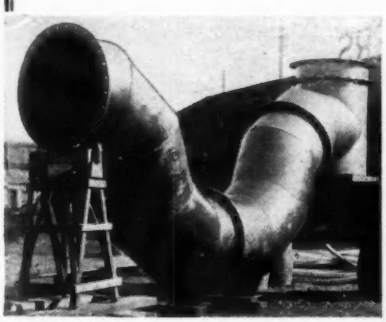
Analysing a recent 12-monthly period, the station handled a total of 914 mill. cu.ft. at delivery pressures

Mild Steel Welded Mains etc.





Mild steel welded mains and pipework of all sizes can be dealt with promptly and economically by our new Fusarc CO_2 automatic welding machine.



DEMPSTER · ELLAND

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ELLAND, YORKS.

LONDON OFFICE: 57 TUFTON ST., WESTMINSTER, S.W.1

ranging between 16 and 22 p.s.i., and consumed an average of 1.32 units of electricity per 1,000 cu.ft. After taking into account the kVA charges and the cost of power (.89d. per unit), the average pumping cost amounted to .545d. per therm. The overall operating cost, including annual charges, attendance and maintenance, amounted to 1.1d. per therm.

As the high pressure load expands and the station is required to do more work, there will be a corresponding improvement in the overall cost per therm, as shown by the curve in Fig. 7.

DISCUSSION

Mr. B. G. H. J. Hawkings (Coventry) opening the discussion said that the tremendous surge forward in design during and since the last war of new types of compressing machinery, had made it possible for the gas industry to employ new gas pressure raising techniques. The decision, therefore, to instal this particular plant was a bold one and showed a pioneering spirit, but no doubt it had now brought considerable satisfaction to those responsible.

The equipment described had been carefully chosen to provide sufficient capacity to fit in with the demands of the load curve and yet handle the greatly increased volumes of gas economically, but he would have expected that the Washwood Heath plant would have been in operation over longer periods, with the Windsor Street plant used at peak periods; perhaps this might depend on the availability of waste heat steam.

Referring to the plant capacity, he could not quite understand why two units of .6 mill. cu.ft. per hour would be required for an estimated increase in demand of 1.2 mill. cu.ft. per hour and still act as standby plant. He asked whether Mr. Cormack really meant that plant at Windsor Street would serve as standby, which could not be used out of a total of a potential capacity of 2 mill. cu.ft. per hour. He calculated this spare plant capacity to be .95 mill. cu.ft. per hour.

Mr. Hawkings asked of what material were the compressor blades constructed, and pointed out that for the comparatively small clearances needed, a material with a low coefficient of thermal expansion would seem to be called for. Knowing what that material was, would help to answer the question of rust formation on the blades. He also asked for further information on why an after-cooler had been installed and suggested that it might be necessary because of the large volumes of gas that might be bypassed.

Referring to the control gear, he said that this was a new concept for gas compressors and would call for a high standard of maintenance—unquestionably, preventive maintenance would be a ' must ' on this section of the plant. At first sight the control gear seemed to be a collection of gadgets, but it was clear that all the various controls were necessary for this type of machine and he asked what proportion of the cost of installation, excluding buildings, could be allocated to the control gear.

The overall efficiency of the plant appeared very attractive although it could only be achieved by keeping the load factor as near unity as possible, but over what ranges of pressures and capacity could this type of axial flow machine be constructed. Multiple installations would clearly require the most careful consideration because of the incidental cost of control gear and this might preclude the possibility of their being run in parallel in an attempt to fit plant capacity at maximum efficiency to the load. The reciprocating type of compressor would possibly still be the best type of machine to use for a widely varying load and with the present attention being given to valve design their efficiency would undoubtedly rise.

The axial compressor appeared to be very closely tied to electrical drive, and he asked Mr. Cormack whether he thought that it would lend itself to diesel drive with a possible reduction in energy costs.

Finally, he asked what was the cost ratio between an axial flow installation and a reciprocating compressor installation of corresponding size.

Mr. Cormack, replying, said that it was intended that when standby plant was available at Washwood Heath—after a second machine had been commissioned—the station would operate as long as possible on two-shifts, running approximately 12 hours per day. But until the second machine had been commissioned, prolonged periods of running would be limited to winter peak load conditions.

Washwood Heath had been built as a base load pumping station and the high pressure load characteristic indicated that two-shift working would be needed for a large part of the year.

The estimated increased demand of 1.2 mill. cu.ft. per hour to be handled by Washwood Heath, was an ultimate figure and had been used to determine the final capacity of the station. Initially, the requirements from Washwood Heath would not exceed .6 mill. cu.ft. per hour. As the high pressure load expanded, the reserve capacity at Longbridge high pressure holder station would provide for the deficit between district demand and pumping capacity until conditions made it necessary to instal the third machine at Washwood Heath, thus increasing the capacity there to 1.2 mill. cu.ft. per hour.

The blading for the first compressor had been manufactured from an aluminium bronze alloy containing a large proportion of copper and smaller proportions of aluminium, iron, nickel, manganese and silicon. It had a tensile strength of 28 tons per sq. in. (yield) and 45 tons per sq. in. (ultimate), and possessed excellent corrosion resistant properties, particularly against town gas.

Cooler served two purposes

The after-cooler served two purposes: First, to ensure that only fully cooled gas was passed to the compressor inlet during recirculation, so avoiding a progressive temperature increase at the machine, and secondly, to cool the compressed gas to approximately 60°F. before it was discharged into the high pressure system. While the first was fundamental to the satisfactory operation of the plant, the second function, though not essential, was, however, desirable since it reduced the district condensate collection problem.

On the question of cost, he could not give the specific figures for control gear since the quoted costs provided for the complete installation, including all aspects of control, but he thought that a figure of 10% of the total machinery cost could be taken for this item.

The overall efficiency of the installation varied with the load factor as indicated in Fig. 6, and reference to Fig. 7 showed that a large proportion of the station operating costs could be attributed to fixed charges based upon capital costs, kVA, etc. If the reasonable initial cost of an axial flow installation and the associated economical pumping costs were taken into account, the total station operating costs compared very favourably with those of compressor installations of similar size employing other types of pumping machinery.

The axial flow compressor operated best on high volumetric outputs at moderate delivery pressures, *i.e.*, approximately 25 p.s.i. (gas), but this type of machine was new to the gas industry so it was difficult to specify its range

limits, but a rated capacity of 300,000 cu.ft. per hour might well be the lower economical limit.

The axial flow machine was ideally suited to the high, constant speed electric motor drive, and although a diesel engine could no doubt be employed, its initial cost and the subsequent maintenance costs would not, Mr. Cormack thought, compare favourably with the existing installation. The production of the high speed required might well involve expensive speed increasing gear, which would add to the overall cost of the plant.

Cost comparisons between axial flow and reciprocating compressing plant for the Washwood Heath station were approximately as shown in the table.

Type of cost	Type of plant	
	reciprocating	axial flow
Capital cost index	100	73
Pumping cost index (excluding annual charges)	100	90

Such cost comparisons only related to the Washwood Heath station and were not necessarily typical for all installations.

Mr. J. Foxton (Cheltenham), referring to the very small clearances of the compressor blades, asked whether any trouble with gum had been experienced since the compressor was operating under conditions when the greatest amount of gum was likely to be formed. Gum might be expected on the blades either when c.w.g. was being handled or when the purifiers were not working as well as they should. Mr. Foxton also asked whether the amount of condensate produced had been compared with that encountered with reciprocating compressors and whether it had been analysed to see if it differed from the latter.

Mr. Cormack replied that no gum had been found on the compressor blades, but a deposit had been noticed which had an oily texture and was moist but not sticky. It might be a substance allied to benzole, since it dried off rapidly when exposed to the atmosphere. The condensate had not been analysed nor had it been compared with that from the reciprocating compressors.

Mr. N. G. Earle (Redditch) asked whether the term used in the paper for the substance employed to clean the compressor blades was benzine—a petroleum product—or benzene—a coal tar distillation fraction.

Mr. Cormack replied that the liquid was purchased from a local supplier and was described as benzine.

Mr. J. Bates (Redditch) pointed out that with the compressor operating at 19,000 r.p.m. there must surely be a good deal of noise, and asked Mr. Cormack to comment on this. The specific gravity of the gas being handled played an important part in its rate of flow and he asked whether it was also important in the surge line determination.

Mr. Cormack said that the question of the noise likely to be created by a compressor running at 19,000 r.p.m. had been carefully examined during the early design stages of the plant. Gas Board representatives had visited the works of W. H. Allen Sons & Co. Ltd. and had inspected the running of an axial flow compressor on air. It had been concluded from this inspection that there might be a high level of noise from such a machine operating on gas. Special attention had, therefore, been given to the design of the building and of the gas connections in order to minimise vibration and to reduce generally the overall level of noise.

The internal walls of the compressor room had been acoustically treated with a thin layer of special material and all gas connections had been carried out in spun iron with flexible joints on the compressor outlet and run lead joints on the compressor inlet mains. The use of flexible joints on the delivery mains had presented certain anchorage problems at bends, etc., and particular attention had had to be paid to the design of concrete kicking blocks to counteract anticipated thrusts. The level of noise had in actual fact proved to be considerably below that anticipated and only a relatively small proportion of the overall noise could be attributed to the compressor.

Referring to the specific gravity of the gas handled, he said that the manufacturers had informed them that changes in specific gravity did not affect the surge line characteristics of the machine and therefore did not play a particularly important part during the initial calibration tests.

Mr. W. Owen (Coventry) asked whether the high temperature at the outlet of the compressor (200-210°F.) had caused any difficulties with the flexible joints.

Mr. Cormack replied that before a decision had been reached on the use of flexible joints for outlet connections, he had been assured by the manufacturers that this type of joint would be quite satisfactory at gas temperatures up to 250°F. This had been proved in practice since there had been no leakage from those joints subjected to the high gas temperatures.

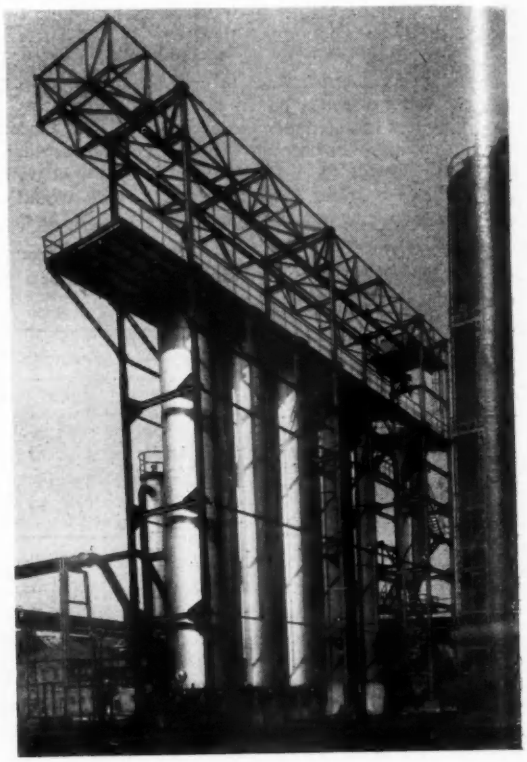
Mr. K. Manuel (Birmingham) asked what type of non-return valve had been fitted in the compressor connections and enquired how the high pressure gas which would come from the projected Lurgi plant at Coleshill would be dealt with.

Mr. Cormack said that the non-return valve was of the simple flap type, suitably weighted to minimise flutter at low rates of gas flow to the district. He went on to explain that the design of valve had been changed in the course of development, and pointed out that the earlier type had incorporated a mechanical linkage which operated the emergency bypass valve when the non-return valve was almost shut. This had ensured that surge conditions would not be encountered before the automatic bypass valve took the necessary action. It had not proved entirely satisfactory and had been replaced by equipment contained within the 'surge detector,' which operated the emergency bypass valve through a photo-electric cell and solenoid. He did not feel able to comment at this stage on the question of high pressure gas from the future Lurgi plant at Coleshill.

In reply to a question by **Mr. R. A. Hill** (Birmingham) asking for details of compressor blade cleaning with benzine, **Mr. Cormack** said that several methods of compressor cleaning had been tried using different quantities of benzine injected at varying times. The most effective had been that using three consecutive one-gal. injections of benzine before the normal daily run. The cleaning fluid was injected while the compressor was coming to rest at speeds between 5,000 and 2,000 r.p.m. The manufacturers did not recommend fluid injection at speeds above 5,000 r.p.m. since this involved a risk of damage to the compressor. He added that benzine was not necessarily the best liquid to use for cleaning the blades. The possibility of using a coke oven by-product was being examined which, if suitable, would show a considerable saving in cost.

Manufacturing rights in this country

KLONNE SYSTEM OF HIGH PRESSURE PURIFICATION



AN agreement has been reached between Westwood & Wrights, Ltd., of Round Oak, Brierley Hill, Staffs, and Aug. Klonne of Dortmund, Germany, for the manufacturing rights in this country of the Klonne system of high pressure and respectively low pressure tower purification according to the German Federal Patent No. 1/012.423 and the British Patent No. 729,265.

This is of considerable significance at the present time when the British gas boards are changing from the conventional methods of gas making to the Continental method of total gasification which requires high pressure gas purification plants.

Deviation from conventional method

The Klonne system of tower purifiers is a fresh development deviating from the conventional method where the purifying material contained in exchangeable trays with two layers, is placed into the towers and respectively removed from them. These trays have hitherto been filled with two layers of oxide one on top of the other. This, however, has resulted in the following disadvantages:—

(1) Discharging of the spent materials is difficult since the supporting structure for the grids and also the centrally located gas distributor tube constrict the clear cross section. Due to the same reasons, the filling of the purifying material in the two layers, one above the other, is rendered difficult.

(2) Since there are two layers of purifying material, the lifting capacity of the crane, for servicing the purifier plant, will be about twice the size of the capacity required for one single layer.

(3) The usual central gas distributor tube cuts through the bed of oxide—the steel or wooden grids for supporting this material have therefore to be cut out and adjusted accordingly.

The Klonne system dispenses with this central tube and attains the distribution of gas by three semi-circular channels located on the periphery of the trays. These are simultaneously used as a three point support and thus achieve a much more favourable pressure distribution and sealing of the trays against each other. In consequence of this arrangement, the trays with the enriched material can be automatically discharged on top of a loading bin and thus manual labour is saved to a large extent. Since there is only one layer of grids in each tray, the grids are bolted down on the supporting frame, they therefore cannot drop out during servicing and consequently their life will be considerably extended.

In this system shut-off valves and connecting mains are provided giving the normal backward rotation. When a purifier tower is to be filled with fresh materials it is disconnected from the system in the normal way, but since the changing of material in one tower can be accomplished in a few hours, there is no fear that the current gas supply will be endangered. This method of operation is, it is believed, more favourable than the high pressure systems now in use, where one has to contend with higher operating costs while saving in initial cost by reducing the number of shut-off valves and connections.

Purifying operation is stopped

When using the latter system, the towers remain in the same sequence in the gas stream; however, the purifying operation is stopped while all the purifier trays on the system are being exchanged so that tower I receives the material from tower II, tower II the material from tower

III and so on, the last tower is then filled with fresh purifying material and the plant put into operation again. Thus the whole plant is stopped when the purifying material in one tower has to be changed. The pressure is reduced to zero, the plant purged, trays rearranged and then repurged again with inert gas and then filled with compressed gas.

Taking into account these accumulated costs and the additional expenditure of wages arising during the service life of the plant it should be easily understood that the higher first cost for additional valving and piping will have been paid for in a few years. Furthermore, there are always the additional sources of danger which may arise by the continual shutting down of the whole plant.

The Klonne high pressure system has proved extremely successful and at the coking plant König Ludwig (Ruhr area) the system has been proved to be absolutely safe in operation and, of all the high pressure purification plants in the Ruhr area, the Klonne plant can show the most favourable operating figures.

Our illustration shows the plant installed at König Ludwig coke ovens; this has been designed for a working pressure of 10 atmospheres and deals with 22½ mill. cu.ft. gas per day.

Use of individual single trays

Summarising these 'Improvements in and relating to Gas Purifiers' (British Patent No. 729,265) the main characteristic is the use of individual single trays for the purifying material in a combination of bottom and top tray; furthermore, the three point support of the trays at the periphery, the gas feed to the purifying material at three points, and the simple discharge and refilling operation by tilting the trays, respectively refilling by hand or by conveyor belt without damaging the rigidly built-in grids.

Improvements incorporated in this patent include:—

(1) The insertion or withdrawal of a filled individual purifier tray will save first cost by the use of an electrically operated crab of quite considerably reduced capacity but with increased hoisting speed. The individual trays being discharged simply by tilting.

(2) The three point support of the trays assures an even pressure distribution and an efficient seal of the individual trays put into the tower one on top of the other. Thus, no short circuiting of the gas stream is possible due to insufficient seals.

(3) Three gas channels, one at each of the three point supports of the individual trays, assure a better gas distribution over the whole area and thus uniform enrichment of the material.

When one tower has been completely enriched all the trays are removed one by one by the fully automatically operating lifting beam, with the object of speedily returning the tower into the stream. The removed trays are placed into a second storage tower, while the trays filled with fresh purifying materials and kept ready in the first storage tower, for immediate use, are placed into the tower offstream. In the period between the changing of two towers, the trays filled with the enriched material are discharged into a bin by tilting them with the aid of an auxiliary winch mounted on the main hoist, and due to the rigidly built-in grids these cannot drop out and consequently do not suffer damage. The empty trays can at any time be filled with fresh materials and stored ready for use in No. 1 storage tower.

This type of operation, taken as a whole, quite considerably reduces the operating cost compared to other systems using double trays and central duct gas feed. Rearrangement of the whole purifying material in the purifier towers with the resultant shutting down of the whole plant, would be even more costly.

I.E.A. EXHIBITION

—continued from p. 334

the stand of **Foxboro-Yoxhall Ltd.,** which included a new series of electronic Consotrol instruments. This range of instruments uses transistorised and magnetic amplifier designs to provide 100% solid state electronic construction. Other exhibits to be seen on this stand—all of them new—were the M/44 series of Motion-Balance pneumatic transmitters for temperature, pressure and humidity; the 11A Target Flow transmitter, a pneumatic force system, and a 15A d/p cell pneumatic transmitter, with a range of 0-5 in. w.g. to 0-25 in. w.g.

Honeywell Controls Ltd., showed a great variety of industrial instrumentation including conventional and miniature indicators and recorders, electric and pneumatic controllers for flow, liquid level and temperature, differential converters for flow and liquid level, actionator valve motors, and combustion safeguard relays. Other equipment, to be seen on this stand were automatic data handling equipment, microswitches—sub-miniature, V_3 high capacity types—and heating and air conditioning controls, operated by electronic, electric and pneumatic components.

Measurement Ltd., who manufacture a wide range of modern meters and pumps, and design liquid process control systems for batch blending systems, exhibited a liquid process control desk using Dekatron equipment, Unipulse liquid meters, flow indicators and cyclometer-computers and Rotoplunge pumps. Other products on view were Polyphase electricity meters and cut-away examples of S type Unipulse meters.

Normalair Ltd., who are Europe's largest and most experienced producers of aircraft air-conditioning and pressurisation equipment, exhibited a range of electronic and instrument apparatus. This was the first time for this firm to take part in this exhibition and their display was intended to illustrate the scope of their manufacturing activities.

Rank Cintel Ltd., exhibited a number of new instruments including an electronic photographic enlarger, a transistor electrolytic capacitance bridge, a square wave generator and 10-Mc/s printed circuits. Other instruments shown included an electronic microscope with particle counting and sizing, and automatic frequency monitors. Colour television equipment was also on view.

Rotameter Manufacturing Co. Ltd., had several items of new equipment on view on their stand which included indictating rotameters fitted with aluminous porcelain floats; they are resistant to corrosion and almost unbreakable. Small rotameters for air purging in a convenient form for panel mounting were shown, so were photoelectric alarms for glass tube rotameters. Other new equipment were transmitting rotameters, dimensionally interchangeable with indicating rotameters of the metric series, and a new version of the R.M. density meter.

The main display on the stand of **Walker, Crossweller & Co. Ltd.,** included the well established range of the Arkon 1600 pressure and vacuum recorders and Arkon 1601 gas flow recorders. The Arkon 1602 flow recorder for high pressure gas, compressed air or steam has lately been added to the range. However, the latest piece of equipment on the stand was the Arkon 60, a portable pressure recorder, in ten pressure ranges from 0 to 10 p.s.i. to 0 to 500 p.s.i. Weighing only 9½ lb., this instrument was sturdy, well finished and suitable for use on test work in the open. A working display of a V notch liquid flow recorder, of particular interest to those concerned with effluent disposal, was also exhibited on this stand.

DISCUSSION

of a paper published in last week's* Gas Journal *— 'Rodding Indicators — a Development in Retort House Technique' by Mr. R. A. Hill

Mr. F. Grocott (Birmingham) said that, at Saltley, 112 retorts were to be equipped with thermocouples and recorders and asked whether Mr. Hill could give an estimate of the amount of maintenance necessary for this equipment. He commented on the reasons given for rises in offtake temperatures following a change of coal.

Mr. Hill replied that the time spent on maintenance at the Saltley installation, where the number of recorders would be reduced since each recorder would have more points, and each would be of the electronic type, would be far less and he therefore estimated that maintenance costs might be about the same as for the 48 retorts mentioned in his paper.

Mr. R. N. Hateley (Birmingham) asked whether there had been any difficulties at Windsor Street with heating up on the platform side of the retorts, even though the alarms had not sounded. He understood that the use of recorders had not adversely affected the yield and his experience from tests made at Nechells was that the yield improved. He asked whether Mr. Hill had found that with reduced throughputs the number of alarms increased considerably.

Mr. Hill said that although no alarm had sounded there might be some indication that the retort was becoming hot on the platform side, but this was very infrequent. At a works in another area board, rodding was only done when the alarms sounded and the experience there was that when retorts did hang on one side only and some time elapsed before the alarm sounded, there was difficulty with these retorts. If throughputs were decreased, there was a considerable increase in rodding and for that reason retorts should always run at their nominal throughputs—the coke yield also improved.

Mr. R. B. Sharman (Stoke) said that he approached the question of offtake temperature control with some reserve. Investigations on the Glover-West retorts at Stoke showed that retorts needed rodding on an average once every four hours. Before an opinion could be formed on this matter, the type of coal, size of retort and the age of brickwork must be considered.

The usual method of controlling gas offtake temperatures by increasing the throughput, had not been found effective at Stoke and the setting of the recorders for the alarms to sound at 250°C. would not work. In his opinion, too, the extension of the curtain plate did in fact lead to a loss of thermal yield. The positioning of the thermocouples was of prime importance. If sited on the top casting, any accumulation of pitch would put them out of action. He had found that a reduction in throughput of the coal carbonised at Stoke gave easier retort working.

Mr. Hill said that he had no experience of the effect of poor retort brickwork on rodding indicator performance but obviously coal travel would be more erratic. Although it was a little early to make any definite claim, it did seem that when this system of rodding was commenced with a new setting, the brickwork remained in a very good condition.

The position of the thermocouple had been the subject of much experiment and the present position was the best for the type of retort. He had not experienced any undue accumulation of pitch on the thermocouples and thought that the difficulties at Stoke were associated with a different design of top ironwork. He could not agree that a reduced throughput normally gave easier retort working—the condition of retorts and the coal carbonised at Stoke must have influenced this.

Mr. A. Griffiths (Wolverhampton) felt that the savings attributed to the installation of recorders had been overstated. Their effect on efficiency and yields might well offset the savings. Nevertheless, it was possible that the condition of the brickwork would not deteriorate so quickly, so that the time between repairs might well be increased from, say, 5 to 6 years.

Mr. Hill replied that although manpower could indeed be reduced without installing recorders, further reduction could be made if they were. As to the thermal yields, the 'gas into holder' figure for Windsor Street was less than the divisional average. As for longer periods between repairs, the setting at Windsor Street on which the recorders had been installed had worked for 3½ years and would shortly be inspected.

Mr. H. B. Bassett (Birmingham) compared a pre- and post work study practice at Swan Village and Walsall works. Observation by the work study officers had shown that the jobs done by top stokers were the same on each installation, with the exception of rodding and that the time values were almost identical. Effective rodding varied according to the individual stoker and the opinion of the technical staff and foremen, but even without offtake temperature recorders, routine hourly rodding had been proved wasteful and unnecessary; it had been reduced on average to each retort, being rodded 2½ to 3 times per shift, though different holes were rodded at differing hours of the shift. It had therefore been possible to reduce the manning to one man per 24 retorts.

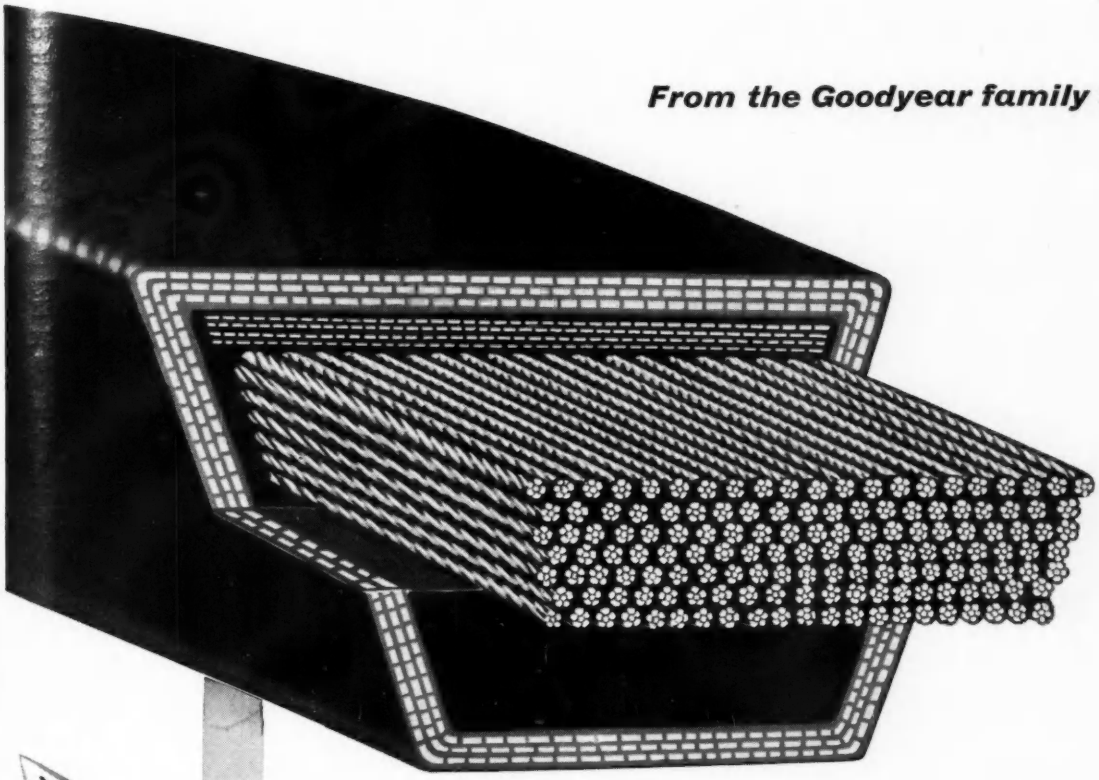
The chief difficulty facing the work study staff was deciding on what frequency to base their allowed time for rodding. The offtake temperature recorder gave factual information and consequently by its introduction a more realistic time value could be introduced. Stokers were allowed sufficient time to rod 28 retorts per shift to the alarm and 20, based on observation, when retorts were found at coaling times not taking their coal.

Comparative time analyses for hourly rodding of retorts for a work study frequency without offtake temperature recorders and for the established rodding frequency at Windsor Street with offtake temperature recorders, clearly showed how a setting of 48 retorts could be manned by one man on bonus; the saving was almost entirely due to reduced rodding. A further advantage of the offtake temperature recorder was that if a stoker had a difficult shift with additional rodding, factual information was available for increasing his bonus payment and compensating for additional effort.

Mr. D. Ferguson (Birmingham) commented that this system of rodding would not affect steaming efficiency, but that any loss of efficiency would be reflected in the tar yield.

Mr. Hill said that with all settings equipped with recorders, there had been an increase in tar yield, but it was only about ½ gal. per ton.

From the Goodyear family tree



TRANSMISSION BELTS

V-BELTS

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IT'S GOT A GRIP ON PRODUCTION

You can't afford lost power . . . costly shut-downs due to transmission failures . . . That's why Goodyear is so often first choice where V-Belt efficiency and reliability is vital. It's best for the job because it's built for the job. From huge multi-vee installations to small F.H.P. applications there's a 'job-designed' belt in the Goodyear family tree to suit every drive and duty. The Goodyear Technical Service is freely available to advise on condition and optimum working conditions for longest, trouble-free performance.

* **E.C.V. for multi-vee installations**
Withstands high starting torques, sudden shocks, pulsating loads. Tough rubber-impregnated fabric preserves belt section, resists side wear and gives positive grip.

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Will absorb the shocks and strains of sudden starting and stopping. Also designed to withstand the high rate of flexing arising from the compactness of short centre, high speed, small pulley drives.

GOODYEAR

THE GREATEST NAME IN RUBBER

The Goodyear Tyre & Rubber Co. (G.B.) Ltd., Industrial Rubber Products Dept., Wolverhampton
Export Enquiries: 17 Stratton Street, London, W.1

Radiant-Heating celebrates golden jubilee

EVEN in the gas industry there are relatively few firms that can boast 50 years' service, and fewer still that have devoted their activities solely to the industrial and commercial side. Congratulations are therefore due to the directors and staff of Radiant-Heating Ltd., who celebrated their golden jubilee on May 14.

It was way back in 1910 that Radiant-Heating Ltd. was formed to market the porous brick surface combustion burner invented by Bone and McCourt and later developed by Mr. F. J. Cox, the company's first managing director. It was in 1933 with the advent of Mr. Arthur Docking, however, that the firm really began to make headway.

Arthur Docking is one of the best known characters in the gas industry; his experience goes back to the time when there were no gas mantles and gas had not begun to be used in industry.

In the early days, as now, overhead heaters were the company's main product, but in those days they operated on high pressure gas or with fan air, instead of low pressure gas as they do today. In spite of a degree of scepticism in certain quarters the new type of heating gradually came to be accepted as a cheap but efficient means of warming almost any type of commercial or industrial building, and slowly but surely the gas industry gave it support by introducing special space heating tariffs. Perhaps the most successful result of this enlightened outlook was at Lincoln where it is estimated that at one time over 15% of the load was attributable to Radiant-Heating appliances.

It is interesting to glance through the oldest sales brochure in existence and compare it with the style of 'sales talk' used today. The foreword reads: 'In remote parts, there are still in existence tribes known as sun worshippers, whose religion is one of the oldest in the world. It is a religion that has controlled their lives for many thousands of years, and is based on the true belief that, if the sun ceased to shine, all would be darkness and death. The sun gives off its health-promoting rays by actuating the ether waves and warming, not the air, but objects which it strikes. The radiant panel heaters described and illustrated in this booklet are suns in miniature, and vibrate through the ether the same health-giving rays. Some time in the near future radiant heat will be better appreciated, and a system that gives its heat solely by convection will not be tolerated'. No doubt this style was very effective in those days, but the company uses crisper copywriting today, and to good effect.

Since the second world war much has been said about outside heating, as though it were a new idea introduced from the continent. The truth is that Radiant-Heating pioneered this field as long ago as the early 1930's, two of their most notable pre-war installations being at the Wembley Stadium and the Paris Greyhound Track.

Nowadays, of course, the Mastertherm range has superseded the Cox combustor for space heating work but even so combustors, because of their exceptionally high radiant efficiency, are still in big demand for process heating, including fluorescent tube baking, glass annealing, core baking, cloth drying and so on.

Another important branch of the firm's business is the manufacture of catering equipment, including not only the radiant heat salamander and the Grill Master, but also a range of sugar boilers as used by Fox's Glacier Mints, Cadbury's, Pascall's and many other well-known confectionery manufacturers.

After withdrawing from the field of cremation for some long while the company decided to come back again and almost immediately obtained an order for a new type cremator for the new Surrey and Sussex crematorium of the South London Cemetery Company. This was quickly followed by an order from West Norwood, another from the Surrey and Sussex and more recently from the Aldershot Borough Council.

It was in 1953 that Arthur Docking, by then well over 70, realising that retirement could not be so far off, decided to dispose of his shareholding to George Wilson Gas Meters, Ltd., of which Radiant-Heating is now an important subsidiary. Mr. Docking in fact continued as managing director but after five years decided to hand over the reins to a younger man, Mr. W. Compton Carr. Little more than a year had elapsed, however, before Mr. Carr was forced to give up his executive duties in favour of a Parliamentary career.

What of the future? Well, obviously overhead and process heating will continue in the forefront of the company's activities, but new products are coming along to broaden its scope. The first of them, the caloric incinerator, has already made a big impact in the commercial field and in time may open up a most useful domestic load, just as it has in America. Other new products are also on their way, although they may not become available until the company moves into new and larger premises early next year.

An outside installation recently completed at Harringay Stadium.

DEVELOPMENT CHIEF NAMED

RESPONSIBLE FOR NEW PROCESSES, INTEGRATION

THE Gas Council has decided who is to lead their new Development and Planning Section. He is 36-year-old Mr. Denis E. Rooke, at present Development Engineer of the South Eastern Gas Board.

The position was first advertised last March to coincide with the announcement that the section was to be formed.

Planning

Mr. Rooke will be responsible for the design and development of full-scale operation of new production processes 'including those discovered by the Council's own research staff, and for planning in conjunction with area boards the introduction of these processes in an integrated national supply system.'

Mr. Rooke was appointed to his present post with the South Eastern Gas Board 17 months ago, having joined the Board in 1949 as assistant mechanical engineer at their coal tar by-products works, of which he became deputy manager in 1954.

Liquid methane

In 1957 he was seconded to the North Thames Gas Board for work in connection with investigation into liquid methane and a year later went to the U.S.A. as Gas Council representative in connection with the trial importation of this fuel.

He was one of the technical team which sailed in the Methane Pioneer on the voyage which brought to this country the first load of liquid natural gas ever carried across the ocean.

END OF GASLAMP ERA FOR ALBERT HALL

Symbol of Victoriana — London's Albert Hall—is to lose its remaining 11,000 gas lamps. A new installation controlling 3,500 electric bulbs has become the building's secondary lighting installation.

Gas price up in N. Ireland town

LISBURN (N. Ireland) Urban Council has decided to increase the price of gas by 2s. 7d. to 13s. 9d. per 1,000 cu.ft.

In a report to the Gas Committee Mr. T. R. Cameron, consultant, said that because of reduced hours for shift workers and a pay rise for tradesmen and labourers, costs would increase by more than £2,000 annually. Since last summer the quality of gas had improved by approximately 20%, which, in effect, was a reduction in price.

It was essential that the price should be increased and reviewed when a bulk supply from Belfast became available. It was left to the officials to recommend a special tariff for industrial users.

NEW INSTALLATION CHARGES FOR NORTH

The Northern Gas Board have drawn up a new scale of charges for mains, service and internal installations for new houses. For only one or two points, charges will be specially negotiated; for three points the total cost will be £7 5s.; for four points £6 10s.; and for five points £6. There will be an extra charge of 15s. for flex, safety plug and socket for washboilers, and 10s. for a connection for a coke-burning fire.

Gas—and rising standards

The gas industry is well able to cater for the needs of rising standards which demand modern labour-saving devices operated at reasonable costs, said Mr. D. Duncan, Perth, when he presided at a luncheon held by the central district committee of the Scottish Gas Consultative Council in Stirling.

SCOTTISH DIVISIONS JOIN UP

THE Scottish Gas Board announce that the central division and the northern division have been amalgamated in the Central and Northern Division under the control of MR. W. NICOL BAIRD with headquarters at Perth. MR. H. S. MILNE, general manager of the former Northern Division, will carry the title of Deputy Divisional Manager and will continue to be based in Aberdeen.

NEWS SUPPLEMENT

BELFAST MAKES HIGHEST PROFIT FOR TEN YEARS

BELFAST Corporation Gas Department showed a net profit of more than £95,141—the highest for ten years, and an increase of £35,524 on last year's figure—during the financial year ended March 31 last.

This was stated in the annual report of the Engineer and Manager, Mr. J. L. Hyslop, which he presented to the committee last week.

The report also says that in spite of the abnormal mildness of the weather and the loss in consumption due to the change-over of street lighting from gas to electricity the total sales of gas for the year showed an increase of more than 26 mill. cu.ft.

The report says that the net profit was favourably influenced by the cumulative effect of a number of items, including a reduction in expenditure on coal of £4,671.

The item that had the most pronounced effect, however, was revenue from rental and sale of appliances. The revenue from this source had increased by £33,222.

Total revenue at £3,190,748 showed an increase of £42,572 and the total cost of manufacture and supply of gas at £2,809,861, was increased by £2,700 so that the gross profit on the year's trading of £380,886 was increased by £39,972.

The revenue total for the year was made up of £2,380,885 (revenue from gas), £126,764 (rental and sale of appliances), £494,963 (coke), £172,872 (tar, ammonia and by-products) and £15,263 (other items).

Sales of gas amounted to 4,888.7 mill. cu.ft.

SURPLUS SITE SOLD

THE Southern Gas Board announce that parts of their former gasholder station at Wimborne, Dorset, have been sold by public auction for £7,100.

The area sold totals about one acre and includes some buildings and a freehold dwelling house. It became surplus due to the progress of the Board's area gas grid. Land has been retained by the board for the booster house, coke storage and a workshop.

CORRESPONDENCE

Dr. Haffner gives his present views on the Centriflovane grit arrestor

DEAR SIR,

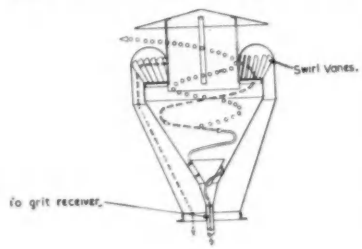
On April 21, 1959, I presented a paper on 'Control of Atmospheric Pollution by Gasworks' to the London and Southern Section, and after some delay due to the printing dispute, this was printed in your issue of November 18. It was subsequently claimed that the widely held view that I had expressed of the mechanism of grit separation in a Centriflovane unit was not in accordance with observable behaviour. I stated:

> 'It was not until blast pressures were increased that it became clearly desirable to install grit arrestors such as the Centriflovane type. Basically it cannot hope to eliminate much finer material than grit, that is above 74 microns, because at one stage in the separation the curtain of separated grits falls vertically into a cone, through which the emerging gases have to pass and obviously carry with them the finer particles.'

Since then I have had the opportunity of observing a 3-in. transparent model and later a full scale 24-in. arrestor fitted with an inspection window and dealing with c.w.g. grits admixed with foundry dust.

My previous view that in the Centriflovane unit separation takes place mainly in a vertical plane does not take into account the effect of the swirl vanes in producing a dominant horizontal component in the motion of the gases and grits. This means that the grits hug the outer wall of the arrestor.

The annular space inside the ring of swirl vanes acts as a vertical cylindrical cyclone with multipoint tangential admission of dirty gas from which the grits separate on the outer side of the annular space and not the inner side and gases do not subsequently pass through the separated grits. This dynamic and three dimensional effect is easier to appreciate in models but the diagram enclosed represents what are now my views of the mechanism.



Centriflovane grit catcher.

The effect I mentioned in my paper may well occur if the swirl vanes were to become so eroded that they ceased to function. There is also some risk that turbulence might interfere with the separation but this possibility has been taken into account in the later modifications of the original Centriflovane Mark I model.

Some reprints of my paper have been issued with my present views incorporated.

Yours faithfully,
A. E. HAFFNER.

Chief Engineer,
Southern Gas Board,
164 Above Bar,
Southampton.
May 27, 1960.

B.G.S.A. and staff representation

DEAR SIR,

Your report on the recent B.G.S.A. annual conference mentioned Mr. E. Crowther's comment on 'the expressed wish of the Association to nominate representatives for gas board membership.'

It should be made clear to your readers that the B.G.S.A.'s desire is for employee representation, in the same way as consumers have representation on boards through the chairmen of the consultative councils. The B.G.S.A. would not presume to suggest that employees most suited to hold such posts would necessarily be found within its own ranks, although it would want the right to nominate, for the Minister's appointment.

The B.G.S.A. is sure that there is, among every board's staff, a person who, while having a first interest in the well-being of the employees, would be able to take his full responsibility as a board member. Arrangements could be made without undue difficulty for him to obtain the general views and opinions of the board's employees through the existing trade union machinery.

By this form of industrial democracy, the B.G.S.A. believes there would be created such a spirit of partnership between management, employees and consumers as would inevitably lead to an even more efficient public service.

The point I must make quite clear is that we do not seek B.G.S.A. representation, but employee representation.

Yours faithfully,
F. C. HENFREY-SMITH.

General Secretary,
British Gas Staff Association,
34, Gloucester Gardens,
London, W.2.
May 27, 1960.

COUNCIL TO AID CONVERSION OF FIREPLACES

KEIGHLEY (Yorks) Town Council has accepted a Health Committee minute recommending grants for conversion of fireplaces in smoke-controlled areas.

The minute proposed that a grant covering 70% of an approved cost should be paid for up to three conversions per household. It recommended that bedroom fireplaces should not benefit from this scheme except where it could be proved that they were in regular use.

The maximum cost for the removal of existing fireplaces and their replacement by an approved open grate or gas or electric fire was fixed at £12.

GAS RECOMMENDED BY SURVEYOR

THE installation of gas central heating on three new housing estates being built by the Gellygaer (Glam.) urban council would probably save money. This was reported to the council by their surveyor, Mr. W. T. Luke, after a visit to Harlow new town and the gas industry's central testing laboratories. He had been asked to study the possibility of installing gas heating on the estates.

Board sells subsidiary

Falk, Stadelmann & Co. Ltd., will acquire from July 1 the gas mantles business previously carried on by Gas Efficiencies Ltd., a subsidiary of South Eastern Gas Board.

The 1960 annual assembly of the International Institute of Welding is to be held in Liege on June 12 to 18.

PERSONAL NOTES

MR. MAURICE S. HALL has been appointed Assistant Home Sales Manager of Bray Construction Equipment Co. Ltd. Mr. Hall, who joined the company in 1957 as a senior area representative, was previously with Dowty Hydraulic Units, where he was in charge of contracts and sales. For seven years before this appointment he was an office manager with George Wimpey Ltd.

MR. L. H. DOWNS, a director of the Power-Gas Corporation, Stockton-on-Tees since 1947, has been appointed Vice-Chairman of the Power-Gas Group of Companies, P.G. Engineering, Ltd., and Ashmore Benson Pease & Co. Ltd., all of Stockton. Mr. Downs is Chairman of Rose, Downs & Thompson, Ltd., Hull.

MR. JOHN V. SHEFFIELD has succeeded LORD VERULAM as President of the Society of British Gas Industries. MR. J. S. CHRISTIE is the new Chairman and MR. F. P. DYSON the new Vice Chairman. The announcement in the May 11 issue was incorrect and we express our apologies for this.

MR. W. E. J. POLLARD has been appointed Station Accountant, Southall works, North Thames Gas Board, following the retirement of MR. O. M. BOWYER. Also appointed are MR. H. J. STAMP and MR. G. A. VERBECK as Station Accountants of the Kensal Green and Slough works respectively.

DR. J. HOLLINGS, O.B.E., has been elected Chairman and MR. J. BISHOP reappointed Managing Director of Nordac Ltd., one of the Woodall-Duckham Group of Companies. MR. A. E. NORMAN remains on the Board and MR. J. AUSTIN has been appointed Technical Director.

MR. C. ROBSON has resigned from the boards of P.G. Engineering, Ltd., and Ashmore, Benson Pease and Co. Ltd., to become Managing Director of Rose, Downs & Thompson. He is to continue as a Director of the Power-Gas Corporation.

MR. C. DOUGLAS BIRKS, the founder of Abbott, Birks & Co., Ltd., has retired from the chairmanship of the company for health reasons. He continues, however, as a director, and his brother, MR. NORMAN A. BIRKS, has been appointed Chairman in his place.

HULL W.G.F. BRANCH CELEBRATES JUBILEE

The Hull branch of the Women's Gas Federation have just ended a three-day celebration of the Federation's silver jubilee. Among the events was a travel talk by Mr. R. Pertwee, Northern Ireland Government representative. They also received some hints on the care and washing of modern fabrics.

Road engineers are too good, says Chairman of the B.R.T.A.

ROAD engineers are their own worst enemy, said Mr. J. Davidson Pratt, C.B.E., Chairman of the British Road Tar Association at a recent meeting of the Association's Eastern Section at Kings Lynn.

Because they kept the roads in such good order the Minister of Transport did not allocate sufficient funds for maintenance.

Mr. Davidson Pratt spoke of the rush to spend unspent money at the end of the financial year. The reason for this was, he said, a lack of forward planning.

Speaking of dense tar surfacing, Mr. Davidson Pratt said that surveyors liked to wait a few summers and winters before committing themselves. Nevertheless, there was a considerable amount of d.t.s. on the roads now which had given good service for five years and its use was increasing. It was an ideal material for car parks because of its resistance to oil and petrol. The oil companies were using d.t.s. for their garages and storage depots.

The long delay in obtaining suitable sites for load-bearing experiments on different materials was also referred to by Mr. Davidson Pratt. He hoped this could be speeded up in order to find the best materials for the motorways which would carry the heavy and fast traffic of the future.

Mr. J. Hunter Rioch, M.B.E., the Divisional Manager of the Eastern Gas Board, chaired the meeting. Also present was Mr. F. T. Brookes, the Deputy Chairman, Eastern Gas Board.

BOARD SEIZES CENTRAL HEATING OPPORTUNITY

MORE than 1,000 central heating units, mostly of the gas fanned warm-air type, were ordered by householders, private builders, and local authorities in the area served by the North Western Gas Board in the 12 months ended March 31 last.

A further 9,529 inquiries received or orders in negotiation, bear witness, says the Board, to the considerable interest in the new system in which air is warmed by a central gas heater, and ducted to several rooms through wall grilles.

The Board believes that this success in securing a good share of the growing central heating market will do much to aid its recovery from the trading setbacks of the last two years.

The new gas central heating is not only going into many of the new housing estates which are springing up all over the north-west, but also into a large number of existing houses.

Staff bake cakes

THE Leeds branch of the Women's Gas Federation held a coffee morning and a tea afternoon with a difference recently. While refreshments were being served the home service staff were actually making and baking cakes on the demonstration platform and the cakes were offered for sale fresh from the oven. The staff had spent the previous day baking and preparing. All proceeds were for the Lord Mayor's World Refugee Fund.

COMING EVENTS

June 4.—EAST OF SCOTLAND JUNIORS: Annual outing.

June 7.—SOUTH EASTERN G.C.C.: Caxton Hall, Westminster. 11 a.m.

June 9.—SOUTH WESTERN G.C.C.: Town Hall, Torquay. 11 a.m.

June 11.—EAST OF SCOTLAND JUNIORS: Golf outing.

WHITBY WILL COOK WITH NATURAL GAS

HOUSEHOLDERS at Whitby, Yorkshire, may be able to cook with natural gas in July. The gas, found under the nearby moors, is being piped to the town, and it is expected that plant now being built at the town's gasworks will be in operation by July. The gas reservoirs are at Aislaby and Grosmont, a few miles inland from Whitby and more than 10,500 yards of 3-in. pipe are being laid to take the gas to Whitby.

HEXHAM WORKS CLOSE

AFTER being in use for 125 years, Hexham (Northumberland) gasworks are to be closed, and in future the area will be supplied with gas from Redheugh gasworks by means of an 8-in. high pressure main. The Northern Gas Board, after ascertaining that Hexham works was incapable of meeting local demand, decided not to extend the works, but to take supplies from the gas grid.

Profit drop foreseen

WOODALL-DUCKHAM, engineers and contractors to the steel, coal and gas industries, have a profit balance of £588,922 for 1959 as against £860,157 for the previous year.

The reduction in profits was foreseen a year ago, when it was pointed out that the 1958 results had been influenced by the bringing of profits from a number of substantial contracts. A dividend total of 25% is being maintained, with a total of 20% for 1959.

MISCELLANEOUS

SHOTBLASTING—METAL SPRAYING—COATING. Epitoke, Araldite, P.T.F.E., P.T.F.C.E., Polythene, P.V.C., Neoprene ano Hypalon coatings applied on site or at works. Loyne, Ltd., Margaret Street, Ashton-under-Lyne, Lancs. Tel. No.: ASH 4551/2/3.

APPOINTMENTS VACANT

WALES GAS BOARD

PONTYPOOL UNDERTAKING

DISTRICT GAS FITTER—BLAENAVON

APPLICATIONS are invited from experienced First Class Gasfitters for the position of District Gas Fitter, Blaenavon District of the Pontypool Undertaking—a District of 1,600 Consumers. The Board will provide a detached house at reasonable rent. Applications in own handwriting should be forwarded to the Undersigned, stating age, experience and qualifications within 10 days of the appearance of this advertisement.

A. Facer, F.C.I.S. M.Inst.Gas E.,
General Manager & Engineer.

Wales Gas Board—Pontypool Undertaking,
P.O. Box 10, Hanbury Road,
Pontypool, Mon.

WEST MIDLANDS GAS BOARD

BIRMINGHAM AND DISTRICT DIVISION

VACANCIES FOR
HOME SERVICE STAFF

APPLICATIONS are invited for the following vacancies:

(a) Home Service Adviser, salary within the range of £503-£614 per annum.

(b) Assistant Home Service Adviser, salary within the range of £403-£549 per annum.

Candidates should have had at least two years' training in Domestic Science, with an appropriate diploma, be capable of working independently and of conducting cookery and laundry demonstrations using gas appliances. Those applying for the higher salaried post should also have had previous Home Service experience.

The posts are pensionable and the successful candidates may be required to pass a medical examination.

Applications, stating age, education, qualifications and experience, should be addressed to Mr. J. E. Wakeford, Divisional General Manager, West Midlands Gas Board, Edmund Street, Birmingham, 3.

SOUTH EASTERN GAS BOARD

DESIGN DRAUGHTSMAN

CENTRAL CONSTRUCTION DEPARTMENT,
AREA HEADQUARTERS,
KATHARINE STREET, CROYDON

APPLICANTS should have a sound engineering training and have experience in design and construction in any of the following branches of work:—

Coal Carbonising and Gasification Plant,
By-Product Plant,
Materials Handling Plant,
Structural Steelwork, and
Steam and Power Plant.

Salary within Grades 6 to 9 (Met. Area) £694-£962 per annum, according to qualifications and experience.

Applications, quoting reference V10/1251 and giving full details, should reach the Personnel Manager, South Eastern Gas Board, Katharine Street, Croydon, Surrey, within seven days.

NORTHERN GAS BOARD

DARLINGTON DIVISION

DIVISIONAL CHIEF ENGINEERING ASSISTANT

APPLICATIONS are invited for the above vacancy. Duties include the preparation of plans, specifications, maintenance and control of all engineering and constructional projects connected with the Division.

The minimum grading for this post is Provincial 'A' Grade APT. 10 (£902-£1,002), but the Board reserve the right to place the occupant, either at the time of appointment or later, in Grade APT. 11 (£931-£1,056) should his qualifications, experience or performance of the duties of the post merit such higher grading.

Applicants must be corporate members of the Institution of Gas Engineers or possess equivalent technical qualifications.

The post is pensionable and the successful candidate will be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with the names of two referees, should be received by the undersigned not later than June 13, 1960.

F. WILSON,
Divisional General Manager.

Gas Offices,
John Street, Darlington.

MSL *have been retained to advise on the appointment of an*

ASSISTANT DEVELOPMENT ENGINEER

for an engineering company employing about 1,000 which has pioneered the development of domestic and commercial heating and catering equipment for over a century.

The Assistant Development Engineer will have specific responsibility for the design and development of gas-fired heavy duty equipment, with wider interests in oil, steam, electrical and solid fuel appliances. He will have contacts at all levels within the company, and with users and suppliers.

Candidates must have broad general engineering experience, including design and production, and a knowledge of heating and catering installations. A B.Sc. degree or professional membership would be an asset.

Preferred age 25 to 35 years. Initial salary in the range £1,250 to £1,500 with non-contributory pension and life insurance. Please send brief details in confidence, quoting reference GU.2211, to J. G. Smith. In no circumstances will a candidate's identity be disclosed to our client unless he gives his permission after a confidential interview at which he will be given full details of the appointment.

MANAGEMENT SELECTION LIMITED, 212, West Regent Street, Glasgow, C.2.

THE GAS COUNCIL

MIDLANDS RESEARCH STATION, SOLIHULL

DESIGN ENGINEER

A suitably qualified engineer is required to take charge of a section responsible for the design of new pilot plants and the subsequent design of prototype units for development on the full scale. The new processes with which these plants will be associated will involve the high pressure gasification and hydrogenation of coal and petroleum and the treatment of the gas produced.

Applicants should have had at least five years' experience in the design of chemical plant and preference will be given to those having high pressure and plant commissioning experience.

Commencing salary will depend on qualifications and experience but will be not less than £1,500 per annum. The appointment is pensionable and subject to medical examination.

Industrial Relations Officer,
WEST MIDLANDS GAS BOARD,
6, Augustus Road, Edgbaston, Birmingham, 15

NORTH EASTERN GAS BOARD

HEAD OFFICE
ENGINEERING ASSISTANT—MECHANICAL

APPLICATIONS are invited for the position of Engineering Assistant in the Mechanical Engineering section at the Head Office of the Board. The salary will be within the Scale £827/£927 per annum.

The duties include, either in whole or in part, the preparation of schemes, drawings, estimates and specifications, for mechanical handling plants and steam raising units and mains, with work of an allied nature.

Candidates must have good Drawing Office and general engineering experience. Preference will be given to candidates possessing the Higher National Certificate or the equivalent.

The successful applicant will be required to pass a medical examination and to join the Board's Staff Pension Scheme.

Application forms may be obtained from the Chief Engineer, North Eastern Gas Board, Head Office, Bridge Street, Leeds 2, and should be returned to him not later than Monday, June 20, 1960.

J. C. GARDNER,
Secretary.

Bridge Street,
Leeds 2.
May 27, 1960.

NORTH EASTERN GAS BOARD

DIVISIONAL CHIEF CHEMIST—
WESTERN DIVISION

Applications are invited for the above position which is based on Bradford, at a salary within Group A (£1,155/£1,235 per annum) of the Senior Officers' National Salary Table.

The successful applicant will be required to control Works Laboratory Staffs and be responsible to and under the direction of the Area Chief Chemist for all chemical control of materials, processes and products, etc., throughout the Division.

The successful applicant will be required to pass a medical examination and join the Board's Staff Pension Scheme.

Application Forms are obtainable from the Chief Engineer, North Eastern Gas Board, Bridge Street, Leeds 2. The completed forms should be received by Monday, June 20, 1960.

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